

U.S. Patent Application Serial No. **10/796,146**
Amendment filed March 12, 2007
Reply to OA dated December 12, 2006

AMENDMENTS TO THE CLAIMS:

Claims 1-10 are presented for examination. Claims 11-29 have been withdrawn. Claims 1, 2, and 7-10 have been amended.

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (Currently Amended): A semiconductor device comprising:

a SiC substrate; and

a heat conductor formed in a first hole in the SiC substrate and made of a linear Structure of carbon elements;

wherein a diameter of the heat conductor is the same as a diameter of the first hole.

Claim 2 (Currently Amended): The semiconductor device according to claim 1, further comprising:

a film formed on the SiC substrate;

a second hole formed in the film on the heat conductor;

an electrode formed in the second hole and directly connected to the heat conductor.

Claim 3 (Original): The semiconductor device according to claim 2, wherein the electrode is a metal stack film whose lower most layer is a titanium layer.

Claim 4 (Original): The semiconductor device according to claim 2, wherein, on an entire surface of the SiC substrate opposite to the film, a conductive film electrically connected to the electrode is formed.

Claim 5 (Original): The semiconductor device according to claim 2, wherein a protective film is formed between the SiC substrate and the film.

Claim 6 (Original): The semiconductor device according to claim 5, wherein a lattice constant of the protective film is a value between lattice constants of the SiC substrate and the film.

Claim 7 (Currently Amended): A semiconductor device comprising:
a SiC substrate having a first and a second surface;
a first heat conductor formed in a first hole in ~~one~~ the first surface of the SiC substrate and made of a linear structure of carbon elements;
a second heat conductor formed in a second hole in the ~~one~~ first surface of the SiC substrate to be spaced from the first hole at interval, the second heat conductor being made of a linear structure of carbon elements; and
an element formed on ~~an other~~ the second surface of the SiC substrate;
wherein a diameter of the first heat conductor is the same as a diameter of the first hole, and a diameter of the second heat conductor is the same as a diameter of the second hole.

Claim 8 (Currently Amended): The semiconductor device according to claim 7, wherein a distance from the ~~other~~ second surface of the SiC substrate to an upper surface the second heat conductor is longer than a distance from the ~~other~~ second surface of the SiC substrate to an upper surface of the first heat conductor.

Claim 9 (Currently Amended): The semiconductor device according to claim 7, wherein the element is an HEMT, and at least a part of the second heat conductor is located between a gate electrode and a drain electrode of ~~[[a]]~~ the HEMT when viewed from above the SiC substrate.

Claim 10 (Currently Amended): A semiconductor device comprising:
a SiC substrate having a first and a second surface;
a first heat conductor formed in a hole in the SiC substrate and made of a linear structure of carbon elements;
a second heat conductor formed to cover ~~one~~ the first surface of the SiC substrate entirely and made of a linear structure of the carbon elements; and
an element formed on ~~an other~~ the second surface of the SiC substrate,
wherein a diameter of the first heat conductor is the same as a diameter of the hole.

Claim 11 (Withdrawn): A semiconductor device comprising:

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a semiconductor substrate with a thickness of 30 μm or more to 200 μm or less; and
a heat conductor formed in a hole in the semiconductor substrate and made of a linear structure of carbon elements.

Claim 12 (Withdrawn): The semiconductor device according to claim 11, wherein the semiconductor substrate is any of a silicon substrate, a gallium arsenide substrate and a sapphire substrate.

Claim 13 (Withdrawn): A method of manufacturing a semiconductor device comprising:
forming a mask film including a window on one surface of a SiC substrate; and
selectively growing a linear structure of carbon elements in the SiC substrate exposed from the window by performing a heat treatment for the SiC substrate, and making the linear structure into a heat conductor.

Claim 14 (Withdrawn): The method of manufacturing a semiconductor device according to claim 13, wherein the heat treatment is performed at a substrate temperature of 1200 $^{\circ}\text{C}$ or more to 2000 $^{\circ}\text{C}$ or less in either of an oxygen atmosphere and a reduced pressure atmosphere.

Claim 15 (Withdrawn): The method of manufacturing a semiconductor device according to claim 13, wherein the mask film is decomposed and a film thickness thereof is reduced by the heat

treatment.

Claim 16 (Withdrawn): The method of manufacturing a semiconductor device according to claim 15, wherein a silicon nitride film is formed as the mask film.

Claim 17 (Withdrawn): The method of manufacturing a semiconductor device according to claim 13, wherein a film is formed on an other surface of the SiC substrate after stopping a growth of the linear structure at midpoint depth of the SiC substrate.

Claim 18 (Withdrawn): The method of manufacturing a semiconductor device according to claim 17, wherein a semiconductor film is formed as the film.

Claim 19 (Withdrawn): The method of manufacturing a semiconductor device according to claim 17, further comprising:

forming a hole with a depth reaching the heat conductor in the film and the SiC substrate; and
forming an electrode electrically connected to the heat conductor in the hole.

Claim 20 (Withdrawn): The method of manufacturing a semiconductor device according to claim 13, wherein the heat treatment is performed before forming an element on the SiC substrate.

Claim 21 (Withdrawn): A method of manufacturing a semiconductor device comprising:

forming a first mask including a first window on one surface of a SiC substrate;

selectively growing a linear structure of carbon elements in the SiC substrate exposed from the first window by performing a first heat treatment for the SiC substrate, and making the linear structure into a first heat conductor;

forming a second mask film on the surface of the SiC substrate and the first heat conductor, from which the first mask film is removed, the second mask film including a second window at a portion spaced from the first heat conductor; and

selectively growing a linear structure of the carbon elements in the SiC substrate exposed from the second window by performing a second heat treatment for the SiC substrate, and making the linear structure into a second heat conductor.

Claim 22 (Withdrawn): A method of manufacturing a semiconductor device comprising:

forming a mask film including a window on a surface of a SiC substrate;

selectively growing a linear structure of carbon elements in the SiC substrate by performing a first heat treatment for the SiC substrate, and making the linear structure into a first heat conductor;

and

growing a linear structure of the carbon elements on the entire surface of the SiC substrate by performing a second heat treatment for the SiC substrate from which the mask film is removed, and making the linear structure into a second heat conductor.

Claim 23 (Withdrawn): A method of manufacturing a semiconductor device comprising:
forming a mask film including a window on a surface of a SiC substrate;
selectively growing a linear structure of carbon elements in the SiC substrate exposed from the window to midpoint depth of the SiC substrate by performing a heat treatment for the SiC substrate, and making the linear structure into a heat conductor; and
polishing the SiC substrate from an other surface to expose a surface of the heat conductor.

Claim 24 (Withdrawn): The method of manufacturing a semiconductor device according to claim 23, further comprising:
forming a protective film exposed on the one surface of the SiC substrate; and
forming a film on the protective film.

Claim 25 (Withdrawn): The method of manufacturing a semiconductor device according to claim 24, wherein the film is formed by a MOCVD method of enhanced lateral overgrowth.

Claim 26 (Withdrawn): The method of manufacturing a semiconductor device according to claim 24, wherein, as the protective film, a film having a lattice constant between lattice constants of the SiC substrate and the film is formed.

Claim 27 (Withdrawn): The method of manufacturing a semiconductor device according

to claim 24, further comprising:

forming a hole with a depth reaching the heat conductor in the film and the protective film;

and

forming an electrode electrically connected to the heat conductor in the hole.

Claim 28 (Withdrawn): A method of manufacturing a semiconductor device comprising:

forming a hole in one surface of a semiconductor substrate;

selectively growing a linear structure of carbon in the hole, and making the linear structure into a heat conductor; and

polishing the semiconductor substrate from an other surface to expose a surface of the heat conductor.

Claim 29 (Withdrawn): The method of manufacturing a semiconductor device according to claim 28, wherein the linear structure of carbon is grown by a chemical vapor deposition method.

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